# TEST REPORT ON

## 26 GA. PBR PANELS
## AT 5' 0" – 3' 9" PANEL SPANS
## WITH SEALED 'N' SAFE™ THERMAL BLOCKS
## IN ACCORDANCE WITH
## ASTM E1646-95 (2003) & E1680-95 (2003)

**TESTED FOR:**
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**Ephraim, Utah 84627**
**Telephone: (435) 283-6550**
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**TESTED BY:**
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**TEST WITNESSED BY:**
**Bala Sockalingam, Ph.D., P.E.**

**TESTING DATES: December 16, 2009**
**REPORTING DATE: December 21, 2009**
**ENCON® Project C1679-1**

ACCREDITED
TL-327

# TABLE OF CONTENTS



# SECTION I
# TEST SUMMARY

# TEST SUMMARY

## 1.1 SUMMARY

Tests were conducted on PBR metal roof panels at ENCON® Technology, Inc.'s Test Facility, Tulsa, Oklahoma. The purpose of the tests was to determine the resistance of exterior metal roof panel system with sealant to water penetration and air infiltration resulting from static air pressure difference between the exterior and interior surfaces. These tests meet the provisions of ASTM E1680-95 (2003) "*Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems*" and ASTM E1646-95 (2003) "*Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference*".

The above-defined tests were witnessed by Bala Sockalingam, Ph.D., P.E., of ENCON Technology. The panels were installed on December 7, 2009 and tested on December 16, 2009.

## 1.2 PANEL SYSTEM DESCRIPTION

The tests were conducted on PBR panels which were 26 ga., 1-1/4" high and 36" wide through fastened panels. Each panel consisted of four major ribs spaced at 12" o.c. as shown on Page 3.

Sealant used in the panel sidelaps was Schnee Morehead Tacky Tape. The nominal size of the mastic tape sealant was 1/2" wide and 1/16" thick.

The panels were attached to nominal 16 ga. (0.06") Cee supports through the 4" thick blanket insulation, Sealed 'N' Safe™ thermal block and 3" thick blanket insulation with #12 x 2" long hex head self-drilling screws with washers. Each panel spanned over unequal spans of 5' 0" and 3' 9". The sidelap fasteners were 1/4"-14 x 7/8" long hex head self-drilling screws with washers and were spaced at 12" o.c.

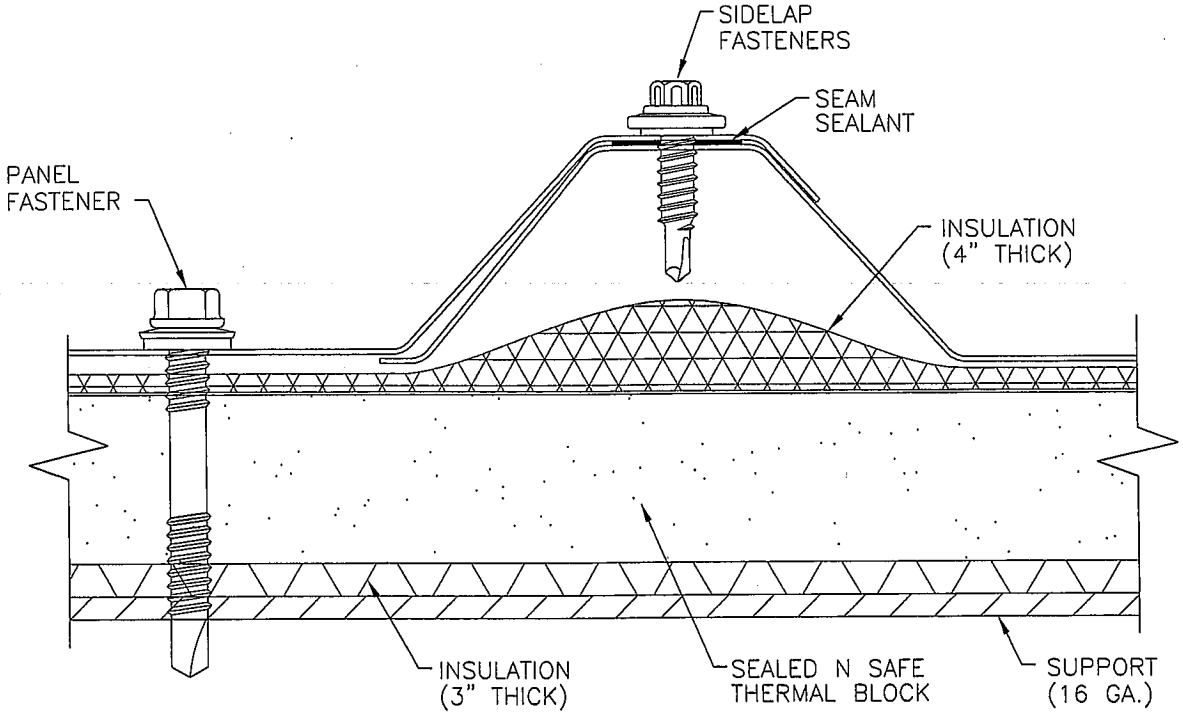
Sealed 'N' Safe™ thermal blocks consisted of two 24 ga. steel plates with polyurethane foam injected between the plates to form a 1" thick block. The length and width of these thermal blocks were 72" and 5", respectively. The blocks were fastened to the supports through 3" thick blanket insulation with #12 x 1-5/8" long pancake head self-drilling screws located at each end of the blocks.

## 1.3 TEST RESULTS

The panel system was preloaded for positive load of 20 psf and negative load of 22 psf. The panel sidelaps were sealed to measure the extraneous leakage of the test chamber and test specimen perimeter. The panel sidelaps were unsealed and the air leakage rates were then measured for static positive pressure difference of 1.57 and 6.24 psf. Upon completion of the air leakage test, the panel system was uniformly sprayed with water at a rate of 5.0 gal/ft$^2$ per hour for 15 minutes at a static positive (inward) pressure difference of 12.0 psf. The results for the two tests are summarized on Page 2.

| ENCON® TECHNOLOGY, INC. | SEALED 'N' SAFE THERMAL BLOCKS TEST SUMMARY | ASTM E1646 & E1680 | 2/16 |
|---|---|---|---|






## CLIP SECTION VIEW

TEST METHOD: ASTM E 1680-95

| TEST NO. | STATIC PRESSURE DIFFERENCE (PSF) | AIR INFILTRATION RATE | |
|---|---|---|---|
| | | ($cfm/ft^2$) | (cfm/lin.ft) |
| 1 | 1.57 | 0.0008 | 0.0024 |
| 2 | 6.24 | 0.0013 | 0.0040 |

TEST METHOD: ASTM E 1646-95

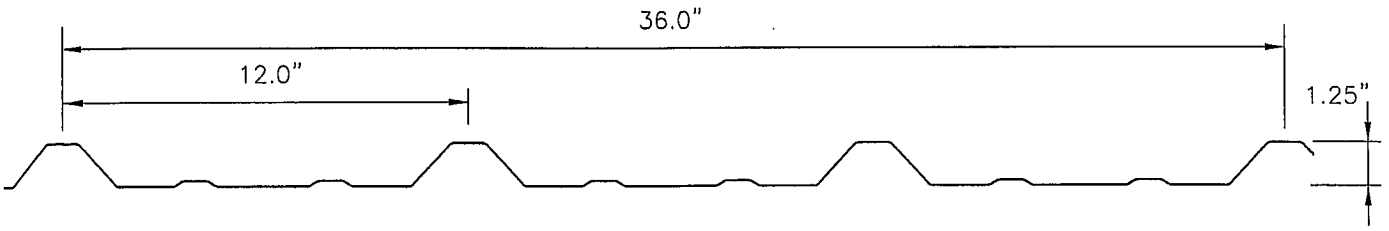
| TEST NO. | STATIC PRESSURE DIFFERENCE (PSF) | WATER INFILTRATION |
|---|---|---|
| 1 | 12.0 | NO WATER LEAKAGE |

NOTES:

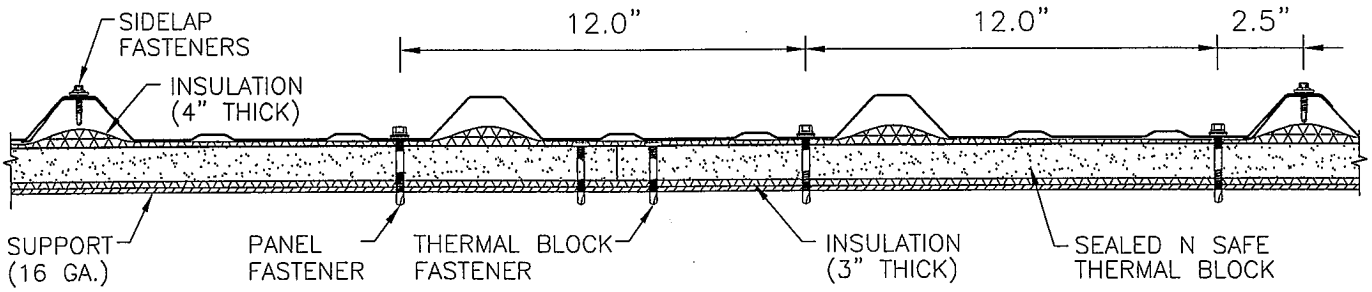
1. 26 GA. PBR PANELS USED IN THESE TESTS.
2. PANELS WERE ATTACHED TO PURLINS WITH #12 X 2" LONG SDS @ 12" O.C.
3. SIDELAP FASTENERS WERE 1/4"-14 X 7/8" LONG SDS @ 12" O.C.
4. PANELS SPANNED TWO UNEQUAL SPANS OF 5' 0" AND 3' 9".
5. SIDELAP SEALANT WAS SCHNEE MOREHEAD TACKY TAPE (1/2" WIDE X 1/16" THICK).

| ENCON TECHNOLOGY, INC. | SEALED 'N' SAFE THERMAL BLOCKS TEST PANELS | ASTM E1646 & E1680 | 3/16 |
|---|---|---|---|

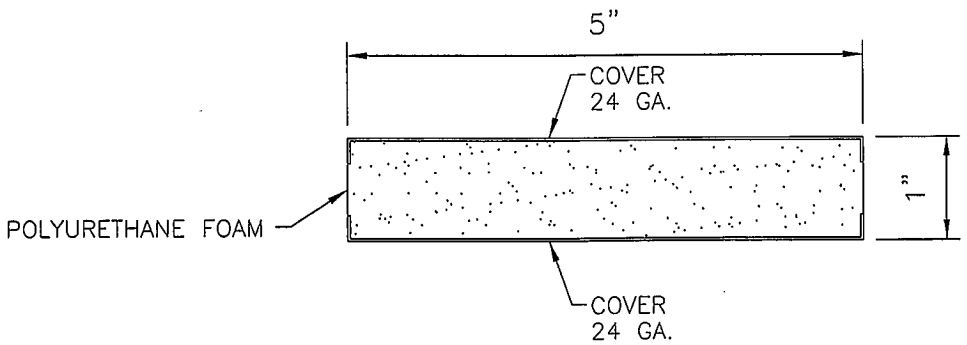





26 GA., PBR PANEL




FASTENER PATTERN




SEALED 'N' SAFE THERMAL BLOCKS

# SECTION II
# DESCRIPTION OF TEST

## 2.1 DESCRIPTION OF TEST

### OBJECTIVES

The purpose of the tests was to determine the resistance of metal roof panel systems to water penetration and air infiltration resulting from static air pressure difference between the exterior and interior surfaces. The test method consisted of the following:

1. assembling the test panel in the test chamber to form a typical roof construction;
2. measuring the air leakage through the panel sidelaps and extraneous leakage of the test chambers;
3. spraying the exterior roof surface with water to determine any water penetration through panel sidelaps

### TEST CHAMBER

The test chamber consisted of a box as shown in the applicable drawings in Section V. It contains one open surface against which the test specimen was installed. One static pressure tap is located at a corner to measure the chamber pressure in such a manner that the reading was not affected by the velocity of the air supply to or from the chamber or other air movement. The air supply opening into the chamber was arranged so that the air does not impinge directly on the test specimen with significant velocity.

### AIR SYSTEM

The compressed air supply consists of a compressor unit capable of maintaining a constant positive or negative air pressure difference for the required test period. A digital manometer was used to measure the test pressure difference with accuracy of 1/100".

### AIR FLOW METERING SYSTEM

A laminar flow element capable of measuring airflow of 40 SCFM was used to measure the air leakage through the panel sidelaps and extraneous leakage of the test chambers. The flow was measured as a differential pressure using a digital manometer and converted to actual flow using regression equation shown on the flowmeter calibration chart.

### WATER SPRAY SYSTEM

The water spray system consists of equally spaced nozzles located at a uniform distance from the test specimen. The system was calibrated to deliver a minimum rate of 5.0 gal/ft$^2$ per hour.

### CALIBRATION

The water spray was calibrated on October 6, 2009 and the air-flow measuring system was calibrated on August 10, 2009.

## DESCRIPTION OF TEST

### TEST SPECIMEN

The overall dimension of the test construction was in excess of 7' 9" x 8' 9". The panels covered unequal spans of 5' 0" and 3' 9". The construction width contained two full panels and two partial panels. The panels were attached to nominal 16 ga. Cee supports through the 4" thick blanket insulation, Sealed 'N' Safe™ thermal block and 3" thick blanket insulation with #12 x 2" long hex head self-drilling screws with washers. The panels were attached to 16 ga. eave, rake and ridge sections with self-drilling screws.

An overflow device that provided a ½" to ¾" deep water pond was installed on one end of the test specimen. The perimeter of the test construction was sealed to the test chamber wall. The perimeter seals between the panels and the test chamber did not duplicate the actual building perimeter details. The details of the methods of construction are depicted in the enclosed test drawings in Section V.

### TEST PROCEDURE

Since the panels were through fastened, no thermal movement of the panel to the support was conducted.

The test specimen was preloaded to a positive load greater than or equal to 15 psf or 75% of the building live load or 50 % of the design positive wind pressure difference. The test specimen was also preloaded to a negative load greater than or equal to 50 % of the building design wind uplift pressure difference.

The panel sidelap was temporarily sealed to measure the extraneous air leakage, $Q_L$, of the test chamber for the specified test pressure difference across the test specimen. The temporary sidelap seal was removed and the airflow through the sidelaps was measured after the test conditions were stabilized for the specified test pressure difference across the test specimen. This measured airflow was designated the total metered airflow, $Q_M$. The air leakage, Q, through the test specimen was equal to $Q_M$ - $Q_L$. The ambient room temperature at the test specimen was also measured.

Upon the completion of the air leakage test, the water spray system was installed over the test specimen. The test specimen was subjected to the specified positive (inward) test pressure difference for 15 minutes while the spray system delivered water on the test specimen at a rate of 5.0 gal/ft$^2$ per hour. The depth and the temperature of the ponded water on the test surface were measured. The test specimen was observed for possible water leakage.

# SECTION III
# TEST RESULTS

## TEST RESULTS

### 3.1 SPECIMEN IDENTIFICATION

| | |
|---|---|
| Panel Manufacturer: | CO Building Systems, Inc. |
| Model Type: | PBR Panel |
| Dimensions: | 36" wide with 1.25" high major ribs at 12" o.c. |
| Panel Gauge: | 26 ga. |
| Panel Fasteners: | #12 x 2" long hex head self-drilling screws with washers (DB Building Fasteners, Inc.) |
| Sidelap Fasteners: | 1/4"-14 x 7/8" long hex head self-drilling screws with washers |
| Sidelap Fasteners Spacing: | 12" o.c. |
| Thermal Blocks: | Sealed 'N' Safe™ - consisted of two 24 ga. steel plates with polyurethane foam injected between the plates to form a 1" thick block. The length and width of the thermal block were 72" and 5", respectively. Polyurethane foam was manufactured by Utah Foam and designated as X10324. |
| Thermal Blocks Fasteners: | #12 x 1-5/8" long pancake head self-drilling screws (DB Building Fasteners, Inc.) |
| Insulation: | 4" thick and 3" thick blanket insulation |
| Support Thickness: | 16 ga. (0.059") |
| Sealant Manufacturers: | Schnee Morehead |
| Panel Sealant: | Tacky Tape (nom. ½" wide x 1/16" thick) |

**Note: All the test materials were supplied by CO Building Systems, Inc. and Sealed 'N' Safe and were not sampled by ENCON.**

## 3.2 TEST DATA

| | |
|---|---|
| Date: | 12.16.09 |
| Panel Manufacturer | CO Building Systems |
| Panel Type | PBR |
| Panel Gauge | 26 |
| Panel Width (in) | 36 |
| Panel Attachment | #12 x 2" long through 4" thick insulation, Sealed 'N' Safe™ thermal block and 3" thick insulation |
| Sealant Manufacturer | Schnee Morehead Tacky Tape |
| Panel Sealant | 1/2" wide x 1/16" thick mastic tape |
| Panel Span (ft) | 5' 0" - 3' 9" |
| Test Area ($ft^2$) | 67.8 |
| Preload Positive Pressure (psf) | 20 |
| Preload Negative Pressure (psf) | 22 |
| Ambient Temperature (F) | 62 |
| Panel Temperature (F) | 62 |
| Barometric Pressure (in. Hg) | 29.71 |
| Water Depth (in) | 0.625 |

**Test Method: ASTM E1680-95 (2003)**

| Test No. | Static Pressure Difference psf | Initial Reading DP (in) | Initial Reading [1] cfm | Final Reading DP (in) | Final Reading [1] cfm | Total Air Leakage [2] cfm | Air Infiltration Rate | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | $cfm/ft^2$ | cfm/lin.ft |
| 1 | 1.57 | 0.680 | 3.442 | 0.691 | 3.497 | 0.0552 | 0.0008 | 0.0024 |
| 2 | 6.24 | 2.173 | 10.963 | 2.191 | 11.053 | 0.0903 | 0.0013 | 0.0040 |

[1] The actual flow is calculated using the regression equation shown on the flowmeter calibration chart.

[2] Total Air Leakage $Q_{st} = Q \times (1.326 \times B / (0.075 \times (T + 460)))^{0.5}$

**Test Method: ASTM E1646-95 (2003)**

| Test No. | Static Pressure Difference psf | Rate ($gal/hr/ft^2$) | Test Duration (min) | Water Infiltration |
|---|---|---|---|---|
| 1 | 12.0 | 5 | 15 | No Water Leakage |

# SECTION IV
# PHOTOGRAPHS

## PHOTOGRAPHS

**PHOTO 1** View of sealant in the panel sidelap.
(DSC00029)

**PHOTO 2** View of PBR panel and sidelap attachment.
(DSC00062)

## PHOTOGRAPHS

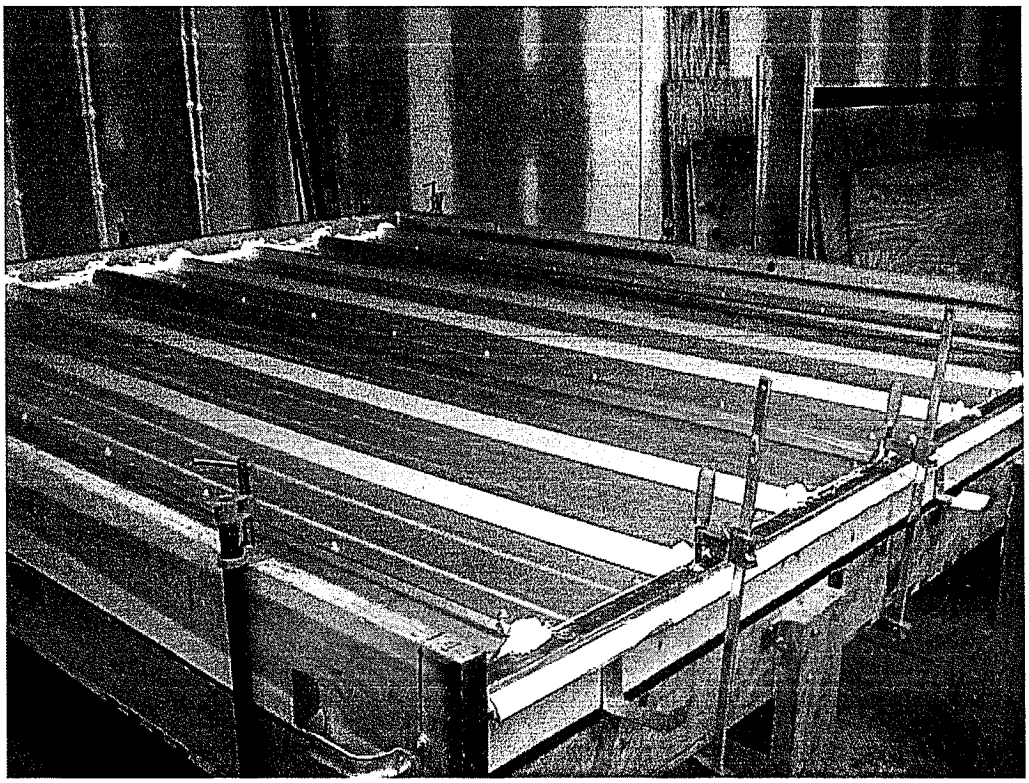


**PHOTO 3** View of test setup. The panel sidelaps were temporarily sealed for extraneous leakage measurement of the test chamber. (DSC00078)

**PHOTO 4** View of the air flow measuring instruments. (DSC00079)

## PHOTOGRAPHS


**PHOTO 5** View of flow measurements at differential pressure of 1.57 psf (equivalent to 0.3" of water). (DSC00083)


**PHOTO 6** View of flow measurements at differential pressure of 6.24 psf (equivalent to 1.20" of water). (DSC00082)

## PHOTOGRAPHS

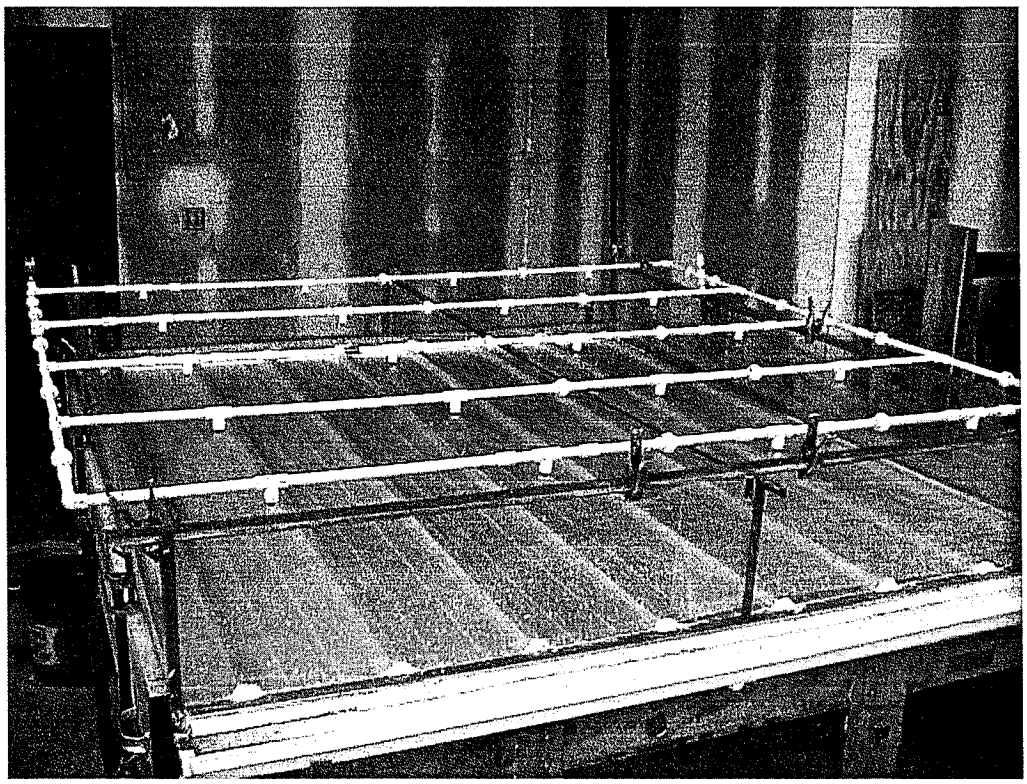


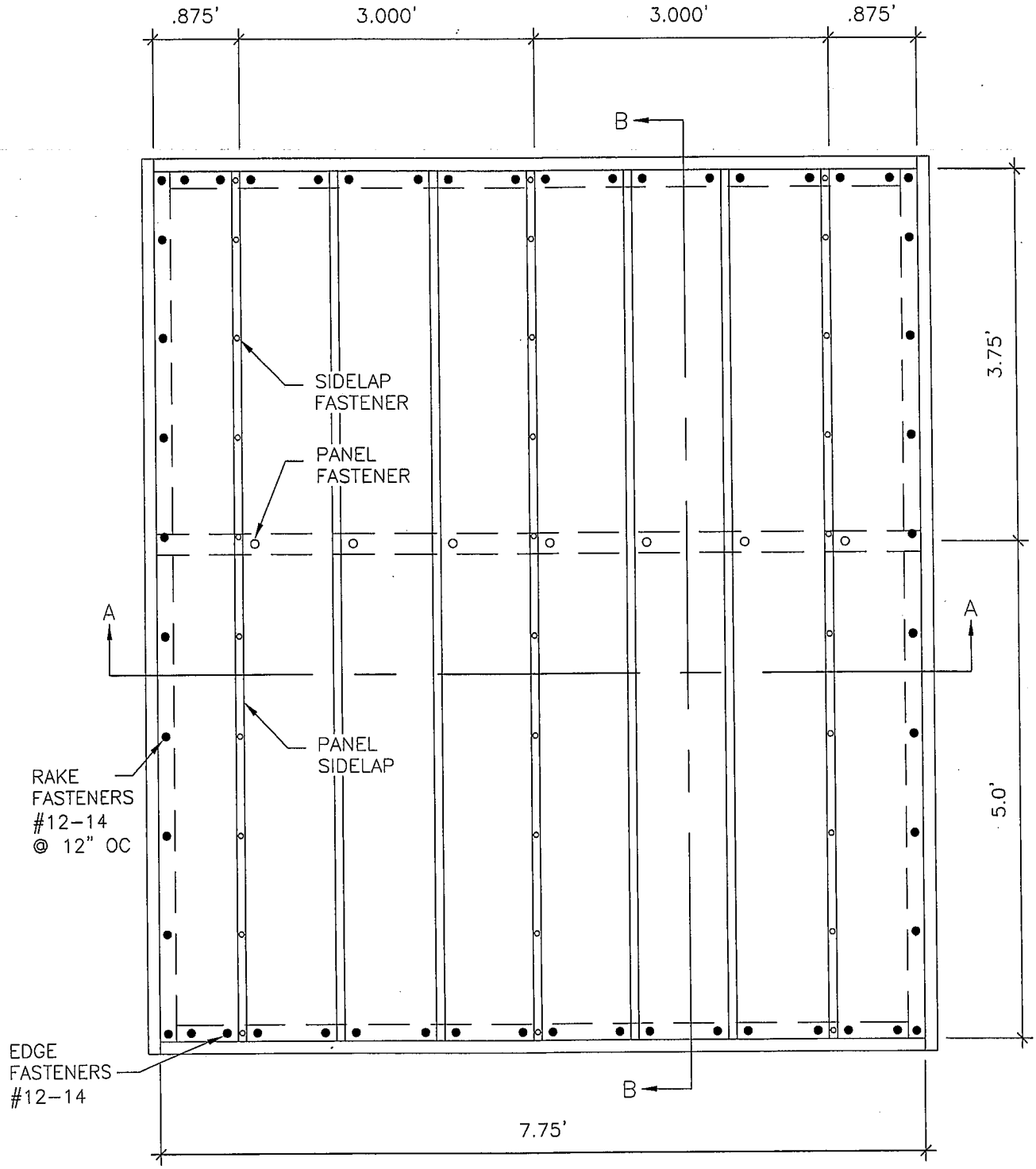
**PHOTO 7** View of water spray test.
(DSC00085)

**PHOTO 8** View of underside of the panel during the water test.
(DSC00089)

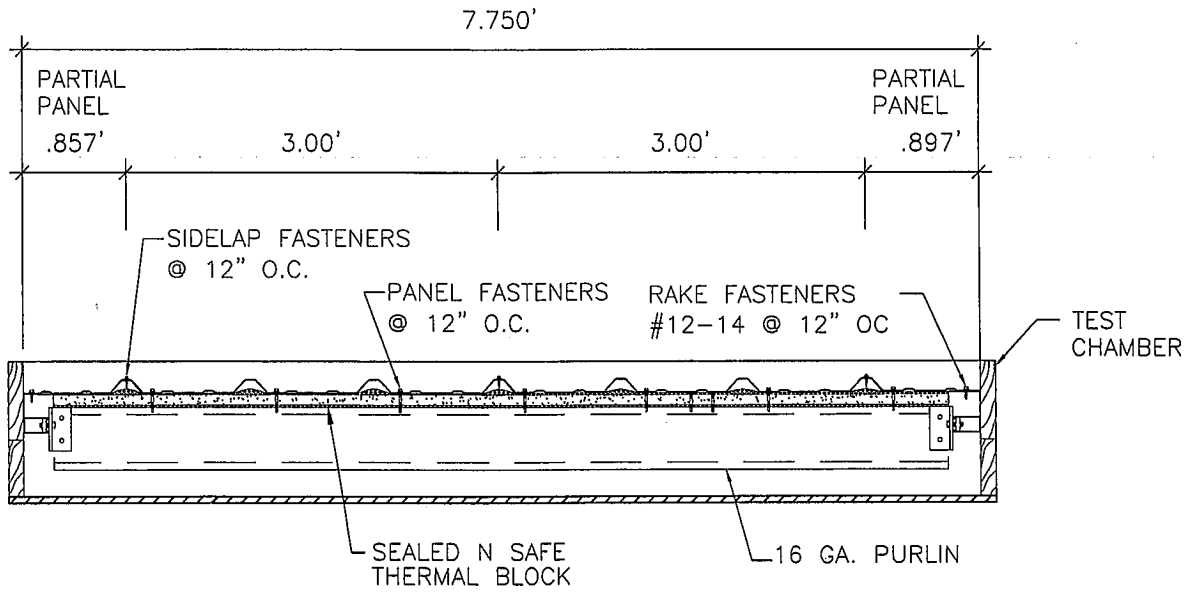
# SECTION V
# APPENDIX

| ENCON TECHNOLOGY, INC. | SEALED 'N' SAFE THERMAL BLOCKS TEST DETAILS | ASTM E1646 & E1680 | 12/16 |
|---|---|---|---|

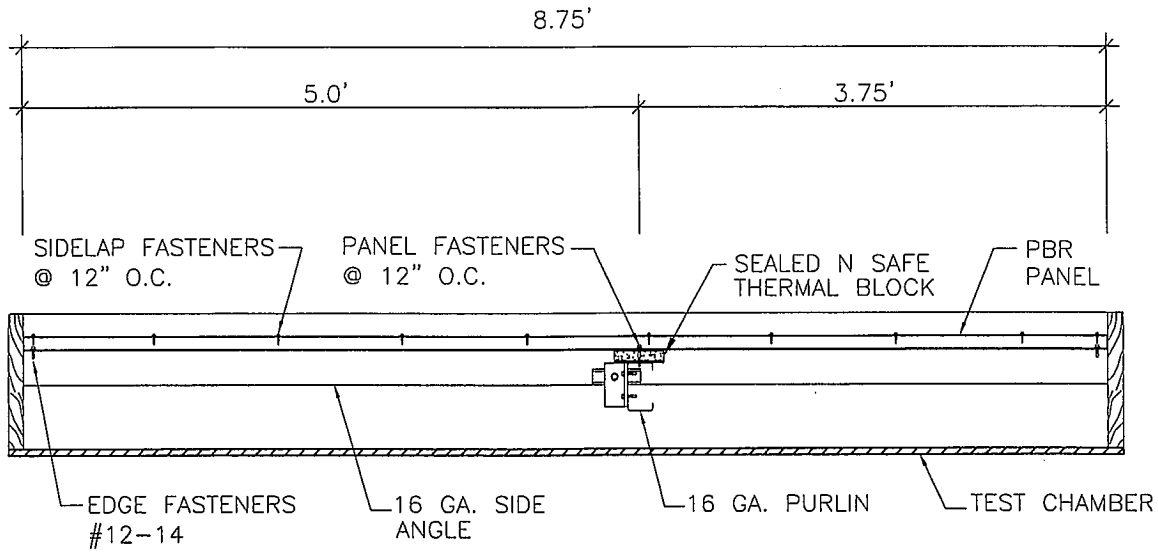





1/1 PLAN VIEW




1/2 SECTION VIEW A-A




1/3 SECTION VIEW B-B

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Scottsdale, AZ 85260
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Fax: (480) 948-3610
www.flow-dynamics.com
sales@flow-dynamics.com

# Calibration Report

| | | | |
|---|---|---|---|
| **Customer Name:** | Encon Technology, Inc | **Report #** | FCAL14552 - 784180-R1 |
| **Customer Address:** | 6717 South Yale Avenue Suite 200 Tulsa OK USA 74136 | | |
| **Customer PO #** | CC | **Received Date:** | 7/8/2009 |
| **Model #** | 50MW20-2 | **Cal Date:** | 7/15/2009 |
| **Serial #** | 784180-R1 | **Lab Temp:** | 75 Deg F |
| **Signal:** | L.F.E. | **Lab Relative Humidity:** | 21% |
| **Calibration Procedure:** | FDP-001 | | |
| **Calibration Tech:** | Keith | **Std. Temperature (Deg F)** | 70 |
| **Fluid Specifications:** | Air | **Std Pressure (PSIA):** | 14.7 |
| **Notes, Adjustments & Repairs** | STP: 70 Deg. F and 14.7 PSIA, | Meter Pres. Measured Upstream | |

**Calibration Results (As Found = As Left)**

| Test Point | Meter Pres | Delta P | Meter Temp | Act. Flow | Std. Flow | C Factor | K Factor | Viscosity |
|---|---|---|---|---|---|---|---|---|
| # | PSIA | In H20 @4C | Deg. F | ACFM | SCFM | Rho*dP/mu^2 | Q*mu/dP | mP |
| 1 | 14.651 | 8.45565 | 78.041 | 42.8259 | 42.0560 | 1.8180E-05 | 936.717 | 184.99 |
| 2 | 14.526 | 7.36231 | 77.433 | 37.7004 | 36.7475 | 1.5742E-05 | 946.149 | 184.81 |
| 3 | 14.413 | 6.43781 | 77.101 | 33.2558 | 32.1851 | 1.3682E-05 | 953.951 | 184.71 |
| 4 | 14.347 | 5.82296 | 76.905 | 30.2534 | 29.1558 | 1.2331E-05 | 959.156 | 184.65 |
| 5 | 14.268 | 5.00972 | 76.735 | 26.2149 | 25.1320 | 1.0560E-05 | 965.772 | 184.60 |
| 6 | 14.194 | 4.22053 | 76.778 | 22.2180 | 21.1883 | 8.8483E-06 | 971.642 | 184.61 |
| 7 | 14.135 | 3.53577 | 76.809 | 18.7187 | 17.7762 | 7.3809E-06 | 977.193 | 184.62 |
| 8 | 14.080 | 2.81703 | 76.805 | 14.9940 | 14.1833 | 5.8576E-06 | 982.446 | 184.62 |
| 9 | 14.026 | 2.06688 | 76.786 | 11.0652 | 10.4272 | 4.2817E-06 | 988.135 | 184.61 |
| 10 | 13.977 | 1.27519 | 76.788 | 6.85805 | 6.44001 | 2.6324E-06 | 992.653 | 184.61 |
| 11 | 13.946 | 0.70896 | 76.812 | 3.82914 | 3.58756 | 1.4601E-06 | 996.936 | 184.62 |
| 12 | 13.928 | 0.36702 | 76.925 | 1.98573 | 1.85771 | 7.5448E-07 | 998.849 | 184.65 |

**Standards Used in Calibration**

| Standard # | Description | Serial # | ReCal Date |
|---|---|---|---|
| FDI-005 | 5 Cu. Ft. Bell, 1 cuft volumes | n/a | 2/09/2010 |
| FDI-120 | Mensor, DPG Model 2104, SN: 531998 | 531998 | 6/04/2010 |
| FDI-123 | Small Bell Cart - mA, VDC, Frequency | n/a | 2/23/2010 |
| FDI-131 | Digital Mensor 2101 Pres. Trans. - 125 PSIA | 532107 | 5/12/2010 |
| FDI-44 | Digital Mensor Diff. Pres. Trans. – 10 "H2O | 241130 | 11/4/2009 |

The instrument referenced above was calibrated using standards traceable to the National Institute of Standards and Technology. Calibration reports for references maintained by FDI are available upon request to the customer of this calibration report. The volumetric flowrates reported are within a best uncertainty of +/- 0.25% of reading. Flow Dynamics, Inc. calibration services are accredited by NVLAP to ISO/IEC 17025:2005 (NIST Handbook 150) and are compliant to ANSI/NCSL Z540-1-1994; Part 1.



I certify the accuracy of this Calibration Report: Andrew Yee (Name) — Calibration Engineer (Title) — Andrew Yee (Signature)

Digitally signed by Andrew Yee
DN: cn=Andrew Yee, o=Flow-Dynamics, ou=Calibration Lab, email=ayee@Flow-Dynamics.com, c=US
Date: 2009.07.15 13:56:48 -07'00'

**End of Report**

NVLAP Lab Code 200648-0

## 5.3 TEST CONDITIONS

### A. OWNERSHIP OF ENCON WORK PRODUCT

All test results developed as a part of this work shall be CUSTOMER's property. All samples submitted to ENCON for testing shall become the property of ENCON. CUSTOMER understands that any test program including procedures and test machines incorporated as a part of this work is a result of continuing long-term research and development by ENCON and because of this all ENCON test procedures, test drawings and other intellectual property relating to this work is and shall remain the property of ENCON. Test samples were disposed of shortly after completion of the tests unless other arrangements were agreed to in writing prior to the test.

ENCON will use its normal procedures to retain copies of the information developed as a part of this test for a period of three years from the date the work was done. This material may be routinely destroyed thereafter.

### B. ENCON GUARANTEE

ENCON guarantees it used its best effort to accomplish this test work. Work done by ENCON was carefully completed by personnel believed to be competent. ENCON tests were based on what was currently believed to be good engineering practices in use at the time of the test.

The safety factors used are generally accepted as suitable to produce safe results. However, good engineering practices and applicable codes and insurance requirements must be taken into consideration in determining if a test procedure is satisfactory for a specific end use. Applicable specifications, good engineering practices and applicable safety factors may change in the future. CUSTOMER should be alert to these changes.

The information and test results presented by ENCON in this test report are offered in good faith based on information ENCON believes to be reliable. This information is offered as a guide to assist CUSTOMER in CUSTOMER's endeavors and does not contain any warranties as to fitness by ENCON. No REPRESENTATION OF WARRANTIES, EXPRESS OR IMPLIED, INCLUDING THOSE OF MERCHANTABILITY AND OF FITNESS FOR A PARTICULAR PURPOSE are made by ENCON, and more specifically, ENCON hereby expressly disclaim such. In no event shall ENCON be liable for ANY CONSEQUENTIAL, INCIDENTAL OR SPECIAL DAMAGES, including, without limitation, labor, transportation, loss of use, loss of profits, harm, personnel injury and damage to property.

If any doubt exists as to the proper means of interpreting or using the test results contained herein, contact ENCON for clarification. CUSTOMER should assure themselves through careful evaluations that test results are suitable for those end uses to which CUSTOMER intends to put them.

## APPENDIX

Information and material provided by CUSTOMER to ENCON was reviewed by an ENCON executive. However, ENCON does not accept the responsibility for accuracy or verification of CUSTOMER's information or the suitability of CUSTOMER materials. Materials supplied by CUSTOMER were tested as received and were not evaluated for code or insurance compliance. CUSTOMER is expected to review the ENCON drawings, tables, test results and other information provided by ENCON to CUSTOMER critically so as to assure CUSTOMER that these presentations, formulas, drawings and other information are accurate and meaningful for the purpose intended.

No other warranties or guarantees shall be issued, implied, delivered or otherwise construed to be issued, implied or delivered.